PART III

PROGRAM DEVELOPMENT
AND STATE ACTION PLAN PREPARATION

The two preceding chapters provide a menu of policy options that states might include in a State Action Plan. This part of the document explains how states can choose from among those options and meld them into comprehensive climate change mitigation programs. It also provides a framework for the actual State Action Plan.

- Chapter 7, *Climate Change Program Development*, is provided help states anticipate institutional, political, and other organizational issues that may complicate their program design efforts.

- Chapter 8, *Analyzing Policy Options*, clarifies the different processes and tools states might use for analyzing and comparing policy options, highlighting the many complexities involved in this process.

- Chapter 9, *Preparing the State Action Plan*, gives examples of the types and content of State Action Plans that EPA feels would support national efforts in this arena and would provide a consistent base for the federal government in allocating additional resources and technical assistance to states.

This information should help state policy-makers anticipate many of the complications that may arise as they structure actual climate change mitigation programs.

CHAPTER 7
CLIMATE CHANGE PROGRAM DEVELOPMENT

This chapter addresses the process of planning, implementing, and administering climate change mitigation programs. It summarizes complexities that states may encounter during the development of greenhouse gas emission reduction policies and describes how several states have structured their programs to deal with these issues. Ideally, the information presented here will help elucidate some of the criteria that may be important when designing programs, including time frame considerations and political and administrative feasibility, as discussed in Chapter 4.

Specific topics addressed in this chapter include the important actors who affect climate change program design, political considerations relating to climate change program development, treatment of time perspectives, interaction between various agencies within and external to state governments, general program administration, and program financing.

7.1 TIME PERSPECTIVES IN CLIMATE CHANGE PROGRAM DESIGN

As highlighted throughout this document, states should anticipate that climate change policy formulation will be a dynamic, evolving process. For this reason, program design frequently depends upon a state's approach for looking at near-, mid-, and long-range issues. Time frame issues are relevant in the political, organizational and administrative aspects of program planning. For example:

- Greenhouse gas emissions today will affect climate change and its impacts at the local level for many decades.

- The capacity to reduce greenhouse gas emissions, especially through log-range mitigation options, depends on anticipated changes in science and technology.

- One reason current emission forecasts are important is that they provide a baseline for analyzing potential emission reduction impacts from various policy options ranging across time frames.

- Dynamic programs with goals and criteria that vary across time frames may be more effective than programs adhering to one static set of objectives. Programs benefit from qualitative and quantitative short-, mid-, and long-range emission reduction targets and goals.

- Policy evaluation, entailing predictions and measurements of probable program impacts, depends heavily on time frame considerations. Key time frame assumptions are critical for conducting emissions analysis and economic impact analysis. These same time frame assumptions play a significant role in driving any formal emissions or climate change modeling efforts a state may decide to pursue.

7.1.1 Structuring Time Frame Considerations in Program Design

Throughout this document time frame considerations are split into near-, mid-, and long-range classifications. This section defines and examines these classifications in more detail, introducing the advantages, constraints, and opportunities surrounding policy planning and implementation within each one.

Near-Range

Near range actions can be initiated immediately. Among other benefits, these policies offer the opportunity to implement immediate emission reductions, set precedents for state actions on climate change, demonstrate new technical approaches for addressing various emission sources, develop an analytic base for future actions, and generate immediate and future political support by incorporating various important actors in high visibility and popular projects. Within this time frame many "no-regrets" policies can often be implemented at relatively low cost.[1]

The primary constraints associated with near-range actions are typically related to the technical, organizational, political, or financial feasibility of alternative options. These constraints stem from the scientific, economic, and technological uncertainty surrounding climate change mitigation measures and from the frequent need to garner support from diverse sectors of society and to coordinate actions between government agencies. (Other sections in this chapter discuss these political and organizational issues in more detail.)

Additionally, without comprehensive and longer-range program design, actions focused on the near-term can come to dominate state programs and drain financial, analytical, institutional, and political resources from initiatives that can have more significant impacts but that will take longer to develop and implement. Also, states that pursue only "no-regrets" actions often find that they do not innovate or develop new policy ideas for addressing greenhouse gas emissions. For these reasons, near-range actions should generally be envisioned as part of larger and more comprehensive programs and should be communicated to the public and other important stakeholders in this way.

Mid-Range

Mid-range policies are often considered in a ten- to twenty-year time frame, hinging on issues such as technology development and implementation feasibility, as well as on emissions and economic forecasts. Policies in this range often involve significantly more analysis, planning, and investment than near-term measures. They also offer significantly greater opportunity for larger emissions impacts.

Mid-range measures can often be designed to integrate with other state policy objectives such as increasing energy efficiency and decreasing air and water pollution. Careful planning can thus yield multiple benefits to the state and enhance political support for these policies. Furthermore, establishing mid- to long-range climate change mitigation objectives can also encourage technical and political innovation. Plans to reduce utility or transportation sector emissions to a certain level within fifteen or twenty years, for example, may prompt policy-makers to develop innovative approaches to greenhouse gas reductions. Policies planned in this time frame should be careful to maintain flexibility so that they can adapt to changing circumstances, such as technical advances or economic downturns.

Long-Range

Long-range actions to address climate change can incorporate specific policy objectives that may take twenty or more years to enact. Successfully encouraging the complete transition in industrial and

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[1] "No-regrets" policies are defined in Chapter 4.

commercial energy use away from carbon-intensive fossil fuels, for example, may take many years. Similarly, it may take several decades to spread and institutionalize comprehensive public awareness at all age levels about climate change issues. These measures may represent fundamental changes in how our society deals with these and other topics.

These long-range actions are perhaps best viewed as visionary objectives that states can support through a variety of near- and mid-term policies. They are sometimes more difficult to establish outside of a general state plan (in transportation or education, for example) because future economic developments, evolution in our understanding of climate change, and impacts from the interaction between various policies are difficult or impossible to forecast.

Even amidst these constraints, however, these approaches are critically important. They often offer the most hope for permanent stabilization of greenhouse gas emissions. Comprehensive state programs established now can set the groundwork and the context for addressing these fundamental, long-range objectives while maximizing near- and mid-range emission reductions the most effectively.

7.1.2 Models for Including Time Frame Considerations in Program Development

States should integrate time frame considerations into program planning to match local institutional and political circumstances. Policy planning may vary, for example, between states where legislatures work full-time and states where legislatures meet for only part of the year. Ideal programs will probably combine and implement policies that consistently address near-, mid-, and long-range objectives. Specific policies may conceivably address all these time ranges while others will concentrate their impact within only one time frame.

A variety of organizational structures for program design can support policy development amidst these complications. Three possibilities are discussed below in detail, and examples are provided.

Mid-and Long-Range Program Targets Coupled With Near-Term Policy Plans

The State of Oregon developed a program structure that incorporates a mid-range emission reduction objective with repeated two-year emission reduction plans (Oregon, 1990). According to policy-makers in that state, one of the foremost benefits of this approach is that it provides a formal program target in the mid-term that prevents the state from delaying action on this issue, while at the same time utilizing a structure that incorporates opportunities for program development, evaluation, and revision every two years as necessary. This flexibility offers the opportunity for policy-makers to respond to scientific, economic, and political changes, and to make program adjustments based on organizational and administrative issues as well.

One apparent detriment of Oregon's set mid-term target is that it seems to have impeded consideration of potentially important policy options with longer-term orientations. For example, transportation and land-use changes that would take more than twenty years to implement or to produce emission benefits are largely excluded from a system that establishes a mid-term goal with no incentives for longer-term policy development.

Immediate Action to Initiate the Climate Change Policy Formulation Process

Some states have taken immediate-term action on this issue before conducting more comprehensive program planning efforts. For example, Missouri, Vermont, and other states have authorized and conducted climate change studies. Long-term benefits from these efforts seem mixed. In some areas these types of studies have helped set the climate change policy formulation process in motion, generating interest among actors and setting the stage for future action. However, in other areas these studies have provided little momentum, and either further action has not been taken, or it has been delayed.

Iowa's experiences illustrate this point. The Iowa Department of Natural Resources conducted an initial inventory but has taken little coordinated action since then to address climate change specifically, although it has pursued other initiatives, such as energy-efficiency and water pollution reduction programs, that simultaneously help reduce greenhouse gas emissions. Their initial action on climate change has yet to lead to a more structured program for dealing with this issue.

California's initial work on climate change, on the other hand, helped generate significant public and political interest in this issue. As part of their actions towards producing a complete policy report on climate change and greenhouse gas issues, which was mandated by its legislature, California developed an initial interim study that seems to have encouraged many different private and public interests to become involved. The interim study made it clear that the state would be taking further action in this field. Without the mandate for the later policy report, some policy-makers in California are uncertain as to whether the initial report would have generated so much public interest.

Feasibility and "No-Regrets" Standards to Structure Policy Choices

Another approach to initial policy development necessitates that policies be based on factors such as technological feasibility and cost-effectiveness. This conservative approach may span all time frames; in California it is based on the state's intent to initiate select measures which have greenhouse gas reduction benefits, while also completing more policy research that may lead to expansion and refinement of the emission reduction program. "No-regrets" policy guidelines frequently offer similar advantages. These types of guidelines initiate policies that are completely beneficial to the state and may help build political consensus for further action. Both the feasibility-based and no-regrets approaches may help reduce political resistance to new programs while demonstrating some action to address climate change.

These approaches can also suffer from the same constraints as those discussed in the above section (Immediate Action to Initiate the Climate Change Policy Formulation Process). Without implementing some direct mechanism or incentive to initiate actual policy development, like a quantitative or qualitative mid-range target or a specific mandate to action, these feasibility-based and no-regrets actions do not always propel states towards further action. The highest utility from no-regrets and feasibility-based actions seems to come when they are combined with other incentives within the context of larger or more structured programs, perhaps as part of a longer-term no-regrets plan.

7.2 IMPORTANT ACTORS IN CLIMATE CHANGE PROGRAM DESIGN

Interactions between several distinct types of actors set the context for climate change programs. These actors maintain resources and knowledge that contribute to policy development, determine program structure or policy content, or influence program design in other ways.

Specific organizations and individuals will vary in each state depending on how programs address sectors, including transportation, energy supply, energy use, forestry, industry, and agriculture. Some will participate during the initial phases of program design, while others will be more active during policy implementation or long-term program administration. Six broad categories of actors are presented below:

- *Private sector interests*, who often maintain significant data and analytic capabilities relevant to emissions planning, and who may be affected by new emission reduction policies;

- *Citizen and advocacy groups*, including those in the environmental, commercial, health and safety, and scientific fields;

- *State agencies*, which maintain government data and analytic capacity, as well as policy and implementation jurisdiction in the sectors that may be expected to reduce greenhouse gas emissions;

- *State governmental executives*, including those concerned directly with climate change, those involved in managing the state economy, and those who may be prompted to comply with federal initiatives regarding climate change or other policy issues that affect the above-mentioned sectors;

- *Legislators*, whose interests and concerns may vary with regards to the impact of climate change mitigation policies on their constituents, including state citizens and other representatives from the various economic sectors that produce emissions;

- *Federal agencies*, especially those whose field programs in states may be affected, as well as those that provide grant monies, other funding, or technical assistance supporting states' climate change programs.

7.3 POLITICAL CONSIDERATIONS IN PROGRAM DEVELOPMENT

Political feasibility may be one of the foremost criteria for policy selection and program structuring. In some circumstances political controversy has inhibited aspects of state-level program development while, in other situations, deliberate planning around political issues seems to have strengthened program design. States may want to think strategically about how to structure programs in order to draw input from the various important actors while minimizing unnecessary political confrontation.

Political controversy in this field frequently stems from the multi-sector, long-term, and scientifically and economically complex nature of climate change issues. In this context, many of the important actors listed above may see their interests threatened and become concerned about government action. This frequently includes individual citizens and their elected representatives who are aware that these emission reduction policies can significantly impact peoples' lifestyles. Public interest groups, utilities, industry, state legislators, and various state agencies may share certain perspectives and disagree on others. These perspectives may also vary between initial policy planning, program implementation, and ongoing program administration.

While interactions between the various important actors will result in different political dynamics in every distinct situation, recent state experiences highlight three consistent topics that states with new or changing programs may want to consider. States may want to investigate how they can develop programs and processes that foster broad-based political support, how they can use particular policies strategically within the time frames of program development, and how they can plan and utilize legislative and executive actions strategically, when feasible. In addition to summarizing these issues below, discussions throughout the rest of this chapter reflect these types of political complexities and ways states might deal with them.

7.3.1 Developing Programs and Processes that Foster Broad-Based Political Support

Because so many distinct types of actors have an interest in and influence over climate change policy formulation, programs without broad-based support may have difficulty building the momentum necessary to initiate emission reduction policies. Furthermore, climate change mitigation efforts often depend not only on fostering enough political support to initiate programs, but also on continuing support and action to carry out program objectives. For example, states may need direct action by private sector actors to assist in actual emissions reductions; support from citizens groups to communicate with different sectors of the general public; and data and skills from various agencies to complete complex analyses. For these reasons, any program planning that excludes or offends important actors can potentially lead these actors to inhibit program development, either through direct political confrontation or by withholding analytic, enforcement, and other institutional resources.

At the same time, states may encounter organizational and administrative problems if they incorporate too many tangentially connected actors into planning and implementation processes. Some states have indicated that, because of the broad nature of this issue, groups with diverse interests marginally related to climate change have sought to become involved in state planning processes. While their political support may be valuable, states should carefully weigh this against additional burdens that might arise from incorporating distinct actors with agendas beyond the purview of the state's vision of climate change policy formulation.

7.3.2 Using Policies Strategically Within the Time Frames of Program Development

Near-, mid-, or long-range policy criteria may include requirements that some policies help bolster a program's political strength in addition to directly affecting greenhouse gas emissions. For example, policies can be designed to demonstrate success and win broad based support immediately. Alternatively, they can foster the support of specific actors through other mechanisms in the immediate or longer terms.

Examples of policies that may strengthen overall program support immediately include projects with highly visible results that readily demonstrate net benefits to the state while reducing greenhouse gas emissions. For example, aggressive programs that quickly demonstrate the benefits of residential and commercial energy-efficiency efforts or methane processing at landfill sites can encourage citizen groups, politicians, and industries to support state climate change mitigation efforts. These projects emphasize quick success in order to build constituencies and consensus.

States may also find it valuable politically to develop projects advocated by specific citizen or industry groups. Inclusion of such projects may help win the support of these groups for the entire climate change program, while the magnitude of their immediate and direct effects on emissions may vary. Urban tree planting programs, advocated by citizen groups, for example, may have a minimal impact on emissions, but they serve to include these important groups in the policy planning process immediately. This can help generate public awareness of climate change issues, and set a precedent for state or local action to address this topic. However, it is important that states avoid diffusing the momentum behind broader climate change program development by casting these projects as initial steps towards addressing this critical issue, not as near- or long-range solutions in and of themselves.

Other policies or projects may not generate immediate political support but can be designed to do so as they evolve over the longer term. For example, states may design public relations programs that publicize annual or bi-annual achievements towards reaching some preset emissions reduction goal and highlight the economic sectors or specific outstanding actors that have contributed. Alternatively, state policy-makers may write provisions into their initial State Action Plan to help ensure that new projects designed around political criteria, among other factors, are implemented every year or two.

7.3.3 Utilizing Legislative and Executive Action Strategically when Feasible

The type of political authorization programs receive can significantly influence how these programs develop. For example, legislative mandates can help circumvent some potentially destructive controversies over policy formulation, while executive directives in many situations permit quicker and more independent performance by agencies. With careful planning, states may accrue additional benefits and avoid particular detriments related to differences between these two modes of program authorization. States should recognize these among other motives for determining how to approach potentially controversial issues.

Oregon and California's experience in setting quantitative programs goals highlights this point; Oregon has produced a quantitative goal while California has not. Oregon's quantitative greenhouse gas emission target was set by the legislature (Oregon, 1990). This fact seems to have helped minimize the political controversy and amount of state resources needed to assist in goal setting. On the other hand, the California Energy Commission has addressed goal setting in a public forum and has experienced high levels of controversy on this unresolved issue (CEC, 1991). While California has achieved other extremely important objectives through the public forum process, the impasse in this case illustrates how political controversy may affect the results of dealing with certain issues through a particular approach.

7.4 COORDINATING CLIMATE CHANGE PROGRAMS: INTERACTION BETWEEN AGENCIES

Climate change mitigation policies across all time frames are likely to require coordination among various state agencies, as well as between states and federal and local governments. In the initial phases of program development, high levels of interaction will help states address the multi-sector nature of this issue by strengthening program comprehensiveness across sectors, garnering broad-based political support, and tapping all available resources for analyzing and addressing greenhouse gas emissions. In addition to facilitating and promoting the initial phases of program design, ongoing coordination between agencies will help facilitate program evolution and dynamic responses to changing climate change and policy circumstances in the future.

Many current and recent state actions to address climate change illustrate the value of interagency coordination from the outset and provide potential models for structuring such interaction. For example, Missouri, California, South Carolina and others have taken deliberate executive or legislative action to coordinate programs between agencies in this field. The sections below provide additional information and ideas on state partnerships, federal and local partnerships, and procedures for coordinating interagency action. It also highlights potential benefits and drawbacks learned through various experiences.

7.4.1 Partnerships Between State Agencies

To be effective, program design, evaluation, and implementation must incorporate the various government agencies that retain policy jurisdiction and analytic capacity regarding these numerous sectors. Initial program design may also benefit from involving state tax and legal agencies. Integration of various state agencies into the climate change policy planning process may:

- *Enhance program planning and analytic efficiency*. Drawing on each agency's expertise and analytic strengths, integrated climate change programs can use the state's current resources efficiently and heighten the program impact. This may include relying on staff in certain agencies to analyze topics within their jurisdiction, like transportation or agriculture, and it may also involve employing the analytic capacities of various agencies to heighten program efficiency, like utilizing an energy office's forecasting skills. In these ways, pooling the substantive and analytic knowledge of climate change program planners efficiently draws on current state resources and helps ensure comprehensive climate change mitigation programs.

- *Avoid program duplication between agencies working on similar or related issues.* With careful coordination, agencies may complement rather than duplicate or damage each other's efforts.

- *Foster a strong political base*. As noted in the previous section, voluntary consensus on policies among the important actors, including state agencies with jurisdiction in the various sectors, strengthens climate change programs significantly.

- *Support strong liaison with industry and citizen groups in each sector*. Where appropriate, new climate change programs can utilize and perhaps strengthen the ties that state agencies in diverse sectors already have with their constituents, instead of duplicating efforts by building the same liaisons and working relationships from the beginning.

- *Improve each agency's existing programs and administrative capacity.* Tying climate change issues to existing programs may enhance the analytic or political legitimacy of climate change-related programs. For example, strategies aimed at reducing emissions of N_2O through the reduction of nitrogen fertilizer use may consider tying this objective to existing and planned groundwater protection programs that stress the need to reduce fertilizer use. Similarly, the threat of climate change may provide additional reasons for establishing or enhancing reforestation programs and improving and expanding energy-efficiency or mass transit. This is the core of the "no-regrets" approach introduced in Chapter 4.

- *Help prepare agencies for future policy developments.* Individual agencies that are involved in program planning may better anticipate how climate change issues will affect them in the longer term. For example, state agencies participating in climate change program planning may gain a broader understanding of how international and national actions, as well as eventual climatic changes, are likely to affect their areas of jurisdiction.

Exhibit 7-1 provides one example of coordination between state agencies that supports greenhouse gas emission reductions.

7.4.2 Interaction With Federal and Local Agencies

Close liaison with other levels of government can also enhance state climate change mitigation efforts. Deliberate linking with federal and with local initiatives can strengthen a program's effectiveness in many ways. For example, in addition to broadening the program's political base, interaction may provide access to additional skills and other resources that programs can draw upon and may help facilitate productive program interaction in areas where jurisdictions overlap, such as the transportation, buildings, and land use sectors.

Exhibit 7-1: The Iowa Agricultural Energy Environmental Initiative

Summary: The Iowa Agricultural Energy Environmental Initiative is a consortium of federal, state, and local agencies and institutions organized to implement an array of projects focused on pollution prevention in agriculture. The Initiative is predicated on the belief that integrated and innovative policy models are required to deal with broad-reaching environmental issues. It insists that agencies cannot work at cross purposes, and that shared resources and expertise can provide better results than individual efforts. The consortium's goal of "accelerating the adoption of improved farm management practices that reduce the environmental impacts of Iowa agriculture, reduce consumption of non-renewable energy resources, and enhance the efficiency and probability of farm management" is implemented through demonstration, education, and research programs. Major parts of this program include the Big Spring Basin Demonstration Project (reducing the use of nitrogen fertilizer), the Integrated Farm Management Demonstration Project (nitrogen management and crop consulting), and the Model Farms Demonstration Project (management of farm resources). While not its explicit purpose, this program reduces greenhouse gas emissions by promoting energy efficiency on farms and by reducing nitrogen fertilizer consumption, which directly lowers nitrous oxide emissions and indirectly lowers carbon dioxide emissions at the energy-intensive plants that produce the fertilizers.

Organization: The Agricultural Energy Environmental Initiative developed through an earlier coalition of groups which convened in the early 1980s to tackle groundwater problems. The initiative operates on three fundamental principles: (1) Interagency coordination consumes time and energy, and therefore depends on a nucleus of dedicated, willing participants; (2) Consensus on all issues is an impossible goal, but a basic consensus on program directions is necessary; and (3) Agency goals or personal egos must at times be sacrificed for group success. The Initiative began by identifying potential participants in the coalition and the problems, needs, and relevant authorities involved in this issue. With each participant's agenda and potential contributions defined, key individuals help apportion human and monetary resources towards projects that are valued by the entire coalition. The primary responsibilities of the Initiative have traditionally rested with the Iowa Department of Natural Resources, although there is no official lead agency. Similarly, the coalition has no explicit structure, although there are formal working agreements for each project. Projects, after being designed, are fit into various agencies' existing programs in order to achieve maximum implementation efficiency and maximum integration into mainstream agency programming. Member groups include: Iowa Department of Agriculture and Land Stewardship, Iowa Department of Natural Resources, USDA - Soil Conservation Service, Agricultural Stabilization and Conservation Service, Agricultural Research Service, US EPA Region VII, Iowa State University, the Leopold Center for Sustainable Agriculture, the University of Iowa, Iowa Soil and Water Conservation Districts, the Practical Farmers of Iowa, and other private interest groups.

Programs: The Initiative creates pilot programs that local authorities or private farms can adopt as public sector enterprises or private businesses. Prior to project implementation, sociological and farm management surveys are conducted in order to ascertain current practices, problems, and willingness and ability of impacted individuals to contribute. Additionally, the program calls for a structured feedback loop from the local level. This loop allows for continual adjustments and corrections based on what is happening where the project is being implemented, and helps generate grassroots support and commitment. A final requirement is long-term feasibility, based on project transferability criteria. Some demonstration projects integrate and support agribusiness in order to enhance long term process and technology adoption. Once a project is formatted, aggressive marketing generates widespread visibility, and an information delivery plan promotes expansion of impacts beyond those directly involved.

In addition to the potential direct benefits from interacting with federal and local agencies, states possess a unique opportunity to encourage the other levels of government to act on the climate change issue. For example, state action and pressure may set precedents for national policy-making, and innovative state programs can provide incentives for cities and localities to design their standard policies to help reduce greenhouse gas emissions.

Liaison with the federal government may be particularly helpful in terms of accessing grant monies and other forms of program financing, enlisting technical support, facilitating areas of overlapping jurisdiction, and mitigating or setting the context for potential future federal regulatory or other action on this issue. This type of coordination is especially relevant, for example, in areas such as transportation policy design, energy efficiency regulation on appliances, and electric utility regulation. In these areas the federal government has taken certain actions that in part preempt what states can do and in part require or empower states to perform other functions.

7.4.3 Structuring Partnerships/Program Coordination and Administration

It is often valuable for one agency, or some other officially designated government body, to maintain responsibility for program coordination. As illustrated below, this may be an existing agency, a specially designated task force, or some other central organizing unit. By providing a central focal point for the various important actors, as well as a central record-keeping and administrative unit, this type of structure may help circumvent coordination and authority problems. Some states report that lack of a formally designated, centrally responsible agency undermines any agencies who do try to act in this area, even if they are instructed to do so by executive or legislative action.

States involved in climate change policy formulation have dealt with this issue in several ways. For example, South Carolina incorporates two interagency feedback loops into their program structure. First, they involve agency heads in program planning and development. Second, they solicit input from program managers and others who are responsible for actually implementing and administering policies. Exhibit 7-2 presents examples of how various states have approached program coordination with regards to climate change.

State policy-makers have also suggested that it is valuable to develop a mechanism for monitoring recent changes in the understanding of climate change mitigation from scientific, economic, and policy perspectives. This may involve recruiting scientists or university staff who are knowledgeable about greenhouse gases and related issues within a particular state for program planning efforts. Monitoring may also involve efforts to keep abreast of current literature and attend professional and academic conferences on this topic.

7.5 CLIMATE CHANGE PROGRAM FINANCING

While this document does not provide comprehensive guidance in program financing, this topic may influence program structure in various ways. For example, sources of available financing can sometimes dictate the direction that new programs adopt. With this consideration in mind, financing mechanisms should closely correlate with pre-determined program objectives and capabilities during the phases of initial program development, program implementation, and ongoing program administration. Similarly, financing mechanisms may change in the transition between near-, mid-, and long-range emission reduction measures. In general, it may be helpful to separate financing mechanisms into three categories:

- *Financing through Existing Revenue Sources*. This may involve direct budget allocations for climate change mitigation activities or inclusion of climate change mitigation programs under the jurisdiction and purview of an existing agency. The latter approach may be appropriate in the many situations where greenhouse gas emission reduction and other policy goals overlap, such as in transportation and energy planning, ground water protection, and wildlife or habitat preservation.

Exhibit 7-2: Examples of State Approaches to Program Coordination

South Carolina: South Carolina issued an executive order that authorizes the State Water Resources Board to administer a climate change task force. This task force is tied to the governor's office and state legislative committees, and makes recommendations on climate change issues to both branches of government. Its membership is drawn from public and private sector groups, including utilities and citizen organizations. It is structured around working groups that focus on the various economic sectors impacted by climate change. The State Water Resources Board, as the administrative agency, helps ensure broad based participation and maintains centralized contact and coordination with all participants.

Missouri: Missouri has established two separate bodies charged with researching and recommending state action on energy futures issues. The first is the Energy Futures Coalition, a broad based, governor appointed body that examines the impact of energy issues on topics such as economic development and state employment. The second is the Energy Futures Steering Committee, an interagency task force formed by the state Division of Energy to examine energy efficiency issues.

Oregon: In 1990, the Oregon legislature directed the state's Department of Energy (ODOE) to chair a 12-agency task force to analyze the potential impact of global warming in Oregon and make recommendations on how state agencies should respond to the threat. In 1991, the legislature further directed ODOE to prepare a strategy to reduce greenhouse gas emissions to a level 20 percent below 1988 levels by 2005. This target level of emission reductions did not represent a formal state goal, but it did provide a focal point around which state agencies could analyze climate change issues. The strategy resulting from this work was presented as a study, not as an actual implementation plan. In 1992, the Oregon Progress Board, a public-private steering committee chaired by the Governor, adopted a formal benchmark to stabilize carbon dioxide emissions at 1990 levels by 1995. Finally, Oregon's Fifth Biennial Energy Plan, produced in May of 1993, directs ODOE to develop a plan to keep Oregon's carbon dioxide emissions at the 1990 levels. The plan will be a specific strategy to achieve the carbon dioxide benchmark. Stabilizing carbon dioxide emissions will then be one of the guiding elements of the Sixth Biennial Energy Plan, which is due in 1995. In conjunction with these efforts, ODOE coordinates working group sessions with participation from throughout the public and private sectors; these working groups study substantive issues such as utility impact, petroleum fuels, CFCs, and other important topics.

California: Legislation established the California Energy Commission (CEC) as the lead agency in a multi-agency study examining climate change issues and required the CEC to produce a climate change policy report. The initial phases of California action in this area are focused on research and information gathering and dissemination. California has yet to produce an actual strategic policy plan, however. The legislation directing CEC to act on this issue established specific topics and economic sectors to be analyzed and mandated that other specific state agencies be involved. CEC expanded the agency list and adopted a public climate change forum for analyzing all aspects of this issue. The state governor also issued an additional directive, without timelines or other guidance, for CEC to examine potential CO_2 emission reduction goals.

- *Developing New or Dedicated Revenue Sources*. This often entails innovative financing schemes, including those that raise money through fees or taxes that help discourage greenhouse gas emissions. Approaches in this area may include "green fees" and other charge systems, dedicated utility taxes or charges, original private sector capital development programs, or other innovative financing. Examples of this general type of financing scheme include carbon and energy taxes that discourage fuel consumption, landfill fees that indirectly help mitigate methane emissions, and permit fees required for timber harvest.

- *Revenue from External Sources*. This includes federal technical support and money from federal grant programs. Similar to intra-state policy overlap with existing programs, as described above, greenhouse gas emission reduction policies may fall under the domain of existing federal programs. For example, sources with potential climate change applications include U.S. Department of Energy funds allocated to improving energy efficiency, U.S. Department of Agriculture funds allocated to improving fertilizer application and management, and U.S. Environmental Protection Agency funds allocated to enforcing the *Clean Air Act.*

CHAPTER 8
ANALYZING POLICY OPTIONS

Climate change analysis requires choosing strategies that effectively balance trade-offs between potentially competing goals in a politically charged environment that is also fraught with technical, scientific, and economic uncertainties. Central to devising an effective climate change strategy, therefore, is a need for researchers to present clear, concise, and relevant information to policy makers. Policy-makers, then, require a framework that allows them to choose among alternative policies, and to compile a coordinated strategy for achieving greenhouse gas (GHG) emissions reductions. The resulting strategy should not only meet overall goals, but should also combine policy options, that are themselves acceptable.

Consistent with this perspective on climate change policy analysis, this chapter is intended to lend some initial structure to the extremely difficult task of analyzing policies in this field, by illustrating some of the concepts and ideas that may help states develop their programs. The information in this chapter provides only the starting point for a climate change analysis. The first section establishes a basic framework that considers each policy option in light of the issues that are most important to each individual state. This section is followed by three sections that discuss how states can analyze and consider the benefits, costs, and other impacts of policy options. Section 8.5 highlights analytical complexities and fundamental social assumptions that state policy-makers will need to address. Finally, the last two sections introduce some of the methodologies or decision tools states might consider using to conduct analyses, presenting both theoretical approaches and specific models and tools that have been developed to address climate change issues.

8.1 ESTABLISHING A CONSISTENT FRAMEWORK FOR POLICY ANALYSIS

A policy analysis framework can provide a consistent lens through which policy-makers can examine all policies. Without such a framework, it can be difficult to compare and assess potential climate change mitigation policies that affect diverse and unrelated sectors of society over broad time frames. This section describes a basic structure policy-makers can use for comprehensive and consistent policy analysis. States may choose to proceed in a less formal manner than this framework suggests; the information presented here is meant to highlight the most important considerations in climate change policy analysis and to offer some tools that can be used to help structure this issue.

8.1.1 Structure of the Policy Analysis Framework

Any framework for evaluating climate change mitigation policies should help decision makers link those policies to a state's goals and priorities. One established approach for structuring this framework is to consider each policy option in relation to a set of explicit evaluation criteria. If those criteria are rooted in the state's fundamental goals and priorities, this structure will provide a link to the state's most important objectives. Chapter 4, *Establishing Emission Reduction Program Goals and Evaluative Criteria*, examines the process of setting goals and criteria in detail. By fostering comparison of policies on a uniform basis, this approach also helps policy-makers assess the relative strengths and weaknesses of the alternatives in a consistent manner, and can highlight areas where further research or analysis is needed.

One analytical mechanism policy-makers can use is a matrix that lists the set of criteria along the top and policy options down the side. The matrix can then be used to indicate how each policy option ranks under each criterion. Exhibit 8-1 presents a sample matrix in this format.

Exhibit 8-1: Sample Policy-Criteria Matrix

The sample criteria, policies, and other data presented in this box illustrate how a policy-criteria matrix can be constructed to help frame the climate change issue and clarify tradeoffs between policy options. Entries in each cell typically provide a brief summary of the performance of a single option with respect to the indicated criterion. Entries may represent the result of sophisticated engineering or economic research or may result from more informal and subjective judgment. The sample data presented here do not represent the results of actual policy analyses.

Criteria Policies	Emission Reductions (Tons of carbon-equivalent emissions annually)	Private Sector Costs (Normalized to base year using 7% discount rates)	Social Equity Ranking (1 = low, 5 = high)	Existing Institutional Capacity (X = yes; blank = no)
Methane Recovery Technology Demonstration	58.4	$0	4 (medium-high)	X
Methane Emissions Tax	123.0	$985,000	3 (medium)	
Alternative Fuel Tax Subsidy	456.9	$43,000	1 (low)	X

The type and level of information used to relate each policy option to each criterion, indicated in the cells or boxes in the matrix, facilitates not only assessing of the policy in light of state goals and priorities, but also examining the tradeoffs between different policy options. For this reason, it is critical to use the same unit of measurement to evaluate one criterion as it relates to all policies. For example, emission reductions from all the various greenhouse gas sources (for example, methane from landfills, nitrous oxides from fertilizer use, carbon dioxide from electricity generation) can be converted to a common scale, such as million kilograms of CO_2-equivalent, using the global warming potential concept;[1] such conversions will facilitate cross-policy assessments of emission reduction potential.

The units of measurement may vary significantly among the different criteria and may be quantitative or qualitative. If precise quantitative data are unavailable or inappropriate, policy analysts may be able to create a relative scale for ranking policies against criteria; this may involve simply classifying policies on a criterion as high, medium, or low, or it may mean developing a ranking system that utilizes some numerical scale. In other situations, simply acknowledging that a policy meets a certain criteria may prove valuable; in the policy matrix, it means entering an "X" in various cells.

8.1.2 Application of the Policy Analysis Framework

[1] Global Warming Potential is discussed in more detail in Chapter 2. It is important to note that this scale is not precise and that it is the current subject of some controversy because of debates over approaches to integrating the life-cycle effects of carbon dioxide.

The framework presented here provides a starting point for analyzing policy options. Depending on circumstances, policy-makers may need to modify the framework during the analysis process. Three particular issues may require restructuring the framework. These include: 1) the need to develop groupings of policies that are evaluated together in order to maximize benefits or avoid conflicts from interaction between options; 2) to iterate or incorporate new data during the evaluation process; and 3) to consider time frame issues within the framework. Each of these issues is discussed below.

Policy Packages or Multi-Option Strategies

The basic policy analytic framework can be used not only to evaluate individual policy options, but also combinations of options. The matrix structure easily facilitates this analysis, with policy packages or strategies listed down the side rather than single policy options. States may wish to consider various policy "packages," which combine options that together reflect a particular strategy. In this way, policy-makers can evaluate the pros and cons of various potential strategies or broad approaches in relation to a constant set of evaluative criteria.

This type of packaging could be relevant when climate change programs are expected to be comprehensive across multiple sectors of society or when a wide array of policy options are being considered for other reasons. States may wish to evaluate a variety of policy combinations, for example, that are designed to encourage both demand side and supply side emission reductions in the energy sector and to promote alternative fuel use at the same time. Packaging can also facilitate comparisons of overall strategies that target different sectors or strategies that start with the goal of complementarity with other state objectives and programs.

Iteration During Program Development

The optimal combination of policies or the best approach for analyzing options may not be apparent at the outset of climate change program planning. Not only may new scientific or economic information develop, but the process of evaluating alternative policies may itself generate new or additional information that should be folded back into the policy analysis. For example, if in the process of evaluating a state's initial list of potential greenhouse gas reduction policies, policy-makers discover unanticipated conflicts between various options, or if political transitions shift the importance of some criteria relative to others, then policy-makers may want to reformulate their approach, develop new options, and conduct the evaluation again.

Time Frame Considerations in the Policy Analytic Framework

Policies can achieve benefits or incur costs in the near-, mid-, or long-term. The timing of policy outcomes (i.e., benefits, costs, and other impacts) should be clear during policy evaluation so that policy-makers can consider how policies and their impacts may overlap in the future, either in terms of achieving direct emission reductions, generating political support, or fostering other inter-temporal results. One option is to conduct separate analyses for each time frame. Chapter 7 discusses time frame issues in more detail and highlights how some policies may in fact be designed in one time frame specifically to foster benefits in another.

Within the matrix format, considering time frame issues may mean sub-dividing relevant criteria into near-, mid-, and long-term columns so that the relative impact of each policy within each time frame can be evaluated and illustrated. This reflects one aspect of climate change that may complicate the analysis but also significantly enhance the information presented. This is especially true with respect to policy goals or objectives that cross time frames, as mentioned above, and may aid in generating high levels of political support in the near term to build consensus for future program expansion.

8.2 ESTIMATING BENEFITS

Whether implicitly or explicitly, policy-makers often try to gauge the social benefits and costs of alternative policies and then pursue those options that offer the highest net benefits. In the case of climate change, quantitative benefit analysis is extremely difficult, because so few of the physical impacts have been quantified at the state level, and even fewer have been monetized. For example, most analysts would agree that quantifying and monetizing all the impacts of sea level rise and climatic influences on agricultural systems, water resources, or biodiversity is beyond current technical and analytic capacity.[2] Accordingly, it is impossible to measure in standard economic terms the value or benefits of preventative policies. Exhibit 8-2 summarizes some of the complications surrounding analysis of the benefits of climate change mitigation policies.

Exhibit 8-2: Complications in Estimating Benefits

Uncertainty surrounds many aspects of climate change, including:

- The magnitude of global average change in temperature, precipitation, and sea level rise;
- Regional projections of temperature change, precipitation, and soil moisture;
- The timing of changes in climate and related variables, such as sea level rise;
- The potential of commercially managed systems, such as agriculture and forestry, to adapt;
- The response of unmanaged ecosystems, including terrestrial and marine vegetation and animal species, to climate change;
- Impacts of climate change on other sectors, such as water resources, coastal wetlands, human health, and energy supply and demand; and
- The value to the public of mitigating these potential impacts.

This does not mean, of course, that it is not worth taking extensive action to mitigate these potential threats. In fact, many policy-makers believe that the foremost public benefit of greenhouse gas emissions reduction policies is to guard against the possibility of devastating impacts to the earth. In this sense, emissions reduction policies become an important insurance mechanism for the states, the nation, and the world, and they are a measure of our society's willingness to pay to prevent or ameliorate the impacts of climate change.

Three primary categories of benefits are somewhat more tangible and measurable, and thus more practical to use in policy planning and analysis. The remainder of this section discusses these categories, while Sections 8.5 and 8.6 provide more information on comparing costs and benefits of various options.

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[2] EPA is conducting extensive research on the benefits of climate change mitigation and on alternative frameworks for dealing with the uncertainties surrounding this issue.

The three categories outlined below include use of greenhouse gas emissions reductions as a proxy for the benefits of mitigating climate change, considering ancillary benefits of emissions reduction policies, and considering political and organizational benefits of addressing climate change.

8.2.1 Using Greenhouse Gas Emissions Reductions as a Proxy for the Benefits of Mitigating Climate Change

Estimating how policies affect greenhouse gas emissions is the most direct way to judge their role in mitigating the threats of climate change. Essentially, greater benefits come with larger emissions reductions. While even estimating a policy's actual level of emissions reductions is not a simple process, it provides a basic structure for comparing the climate change mitigation potential of various policies.

The basic process for estimating a policy's probable effect on greenhouse gas emissions anticipates how implementing the policy will change the equations used to calculate emissions from each greenhouse gas source. These can be changes in the magnitude of the independent variables that drive those calculations or changes in the fundamental structure of the actual equations. Chapter 3, *Measuring and Forecasting Greenhouse Gas Emissions*, examines these issues in detail and provides examples of their application.

To compare emission reductions achieved by different policies, the effect on warming of different greenhouse gases is evaluated on a common scale. For example, equal reductions in carbon dioxide and methane will have significantly different impacts on global warming. As Chapter 2 discusses, the International Panel on Climate Change has established a common measure, called Global Warming Potential (GWP), for comparing the relative impact of the various greenhouse gases. Although there exists some controversy as to the accuracy of GWP estimates at the current time, this scale is widely used by climate change analysts to measure the relative benefits of different emission reduction policy options. In the policy analytic framework, numbers representing emissions reductions for diverse policy options can then be presented and compared. In some cases, estimating the benefits of a greenhouse gas reduction strategy requires a more complex analysis, as illustrated in Exhibit 8-3.

8.2.2 Considering the Ancillary Environmental and Social Benefits of Emissions Reduction Policies

In addition to helping mitigate global climate change, reducing greenhouse gas emissions can provide other benefits. Policies to reduce greenhouse gas emissions from automobiles and electric utilities, for example, can improve air and water quality, with positive consequences for human health and natural systems. Similarly, policies to improve residential, commercial, and industrial energy efficiency can reduce costs and stimulate economic growth and competitiveness. Policies to recycle or reuse waste products can reduce greenhouse gas emissions and simultaneously reduce the need for costly municipal solid waste disposal.

In some cases, these benefits can outweigh the costs of policies designed to reduce greenhouse gas emissions. These approaches are often the most attractive options in the early phases of climate change program design, when program financing and political support may be low or tentative. It is important, however, that states not rely solely on these types of policies since most data indicate the total emissions reductions they can achieve, if implemented throughout the country, would not be enough to reach most climate change mitigation goals. Chapter 7 discusses the favorable and unfavorable political and organizational aspects of these types of approaches in more detail.

Exhibit 8-3: Determining the Value of Manure

When choosing between alternative policies, it may be important to quantify the benefits of a particular mitigation option before a decision can be reached. For example, using the manure from livestock, a farm can reduce its fertilizer consumption and associated greenhouse gas emissions. However, those benefits can be difficult to use to compare policy options unless they are quantified into a common unit of measurement.

Along these lines, the Soil and Plant Analysis Lab of the University of Wisconsin and the Arlington Agricultural Research Service (ARS) have developed a five-step method for determining the nutrient value of manure.

1) Determine the manure load size (volume): For a level box-end spreader, multiply the box length, the box width, and wall height together. If the load is heaped, multiply these factors by the total manure height divided by the side wall height.

2) Determine the manure density: Weigh a 5-gallon bucket of manure to obtain the manure density (weight/volume). Convert density to pounds per cubic foot.

3) Determine load weight: Multiply the load size (step 1) by the manure density (step 2).

4) Determine the pounds of nutrients per load: Multiply the load weight by the pounds of nutrient per ton of manure (which varies by animal type), based on values available from ARS.

5) Determine the total amount of nutrients spread per field or per acre: To determine the amount per field, multiply the pounds of nutrient per load (step 4) by the number of loads per field. Divide this number by the number of acres per field to get the nutrients spread per acre.

This method allows for a direct comparison between the manure and the amount of commercial fertilizer recommended. Thus, the estimated manure value can be used by policy makers in any calculatons necessary for evaluating this particular option.

Measuring and comparing diverse types of benefits across policy options can be difficult. One approach is to assess these benefits in terms of how they will reduce current and future costs for society. This may mean estimating cost savings directly for factors such as improved energy efficiency or reduced fertilizer consumption. Alternatively, it may mean estimating avoided costs of remediation or replacement. The benefits of enacting policies to prevent pollution of a water system, for example, can be measured as the avoided cost of future clean up of that water system and the surrounding environment. Similarly, the benefits of reducing wastes can be measured as the avoided cost of depositing those wastes in landfills.

In other cases, however, society would not have chosen to remediate all damages or replace all lost services. Some benefits, for example, such as reduced emissions of air pollutants covered by the *Clean Air Act*, might not have occurred otherwise. In this case, the benefits are the improvements in human health, visibility, aesthetics, and ecosystem health that result. There are a wide array of analytic and economic techniques that policy-makers can draw from to conduct these benefit calculations. Extensive information on these topics is available in natural resource and environmental economics literature and other current literature. Topical literature assigns monetary or other quantitative values to potential benefits and costs.

However, monetizing certain kinds of benefits of climate change measures, such as ecosystem damage, is subject to considerable analytical uncertainty and often political controversy.

8.2.3 Considering the Political and Institutional Benefits of Addressing Climate Change

Some states have indicated that there can be substantial political and institutional benefits to initiating climate change mitigation programs and pursuing emissions reduction policies. Exhibit 2-3 in Chapter 2 reflects the positive attitudes of many states toward this issue. These benefits may include:

- *public visibility* as a proactive government on this issue, which may enhance the national and international image of the state, set precedents for national action, and inspire other state and national governments to act;

- *receiving special assistance*, such as receiving program support from EPA for developing climate change mitigation programs or receiving targeted aid or technical assistance for particular programs from other national and international organizations;

- *helping the United States meet national goals* and fulfill international obligations, which can be accomplished only if states take strong action; and

- *preparing for the future* by developing the foundation for programs that are likely to grow in importance over time.

As always, these and other potential benefits are only relevant relative to a state's particular goals and priorities. Each state must determine which factors are important to pursue.

8.3 ESTIMATING COSTS

Most policies encompass a range of associated costs. These include, for example, the government's costs for designing, implementing, and enforcing new policies, private sector costs linked to changes in production practices or compliance with new regulations, and costs to citizens in the form of higher prices for consumer goods or more time spent on activities such as recycling wastes. This section provides an introductory outline of how states might account for these costs during climate change policy analysis.

It is important first to distinguish the total cost of a policy option from its incremental cost. Most economists would agree that incremental costs are the appropriate focus of a cost-benefit analysis, although total costs can be important from an institutional or political perspective. Incremental costs are defined as costs that are the direct result of adopting the particular policy under consideration. Incremental costs can be determined by conceiving of a "baseline" scenario that reflects events likely to occur in the absence of a policy change and comparing it to a "policy scenario" that incorporates the likely outcome of the policy option. The difference in costs under these two scenarios reflects the incremental cost.

The incremental costs associated with climate change mitigation policies are those expenditures by individuals or organizations that would not have occurred if the policy had not been implemented. For example, public or private sector recordkeeping activities that would have been undertaken with existing resources should *not* be included in economic cost calculations. However, if the time and effort dedicated to new activities does prevent workers from carrying out tasks they used to conduct, then there is a social cost involved.

The purchase of new emissions-control equipment by industry, for example, often represents expenditures that would not have occurred without government regulation, and is an incremental cost of that regulation. Similarly, the amount of money the government spends designing, implementing, and enforcing that regulation is an incremental cost. These are the costs that policy-makers must consider when evaluating the social welfare implications of different policy options.

Economists distinguish between social costs, (costs that result from lost output or displaced resources) and costs that affect an individual sector, but do not necessarily represent losses to society. The incremental costs described above are "true" social costs. Some policies, however, induce a "transfer of wealth" between members of society but do not represent a new social expenditure. For example, taxes on fossil fuels or nitrogen based fertilizers will result in less wealth for individuals and businesses and more for the government. Because levels of fuel or fertilizer consumption changes in response to higher costs to producers or prices to consumers, there is a social cost to a tax as resources are moved to alternative uses. However, the money that is *transferred between the individuals and the government* is not considered to be a social cost. Transfers, in general, redistribute wealth but do not result in economic costs *per se*. Although, the amount of money the government spends administering the tax is a true social cost. Non-economists may refer to economics textbooks and other current literature for a more thorough explanation of how to estimate costs.

8.3.1 Process for Calculating Social Costs

Social costs that should be considered during economic evaluation of climate change policies can result from expenditures in any sector of society. For example:

- State and local governments may incur incremental costs associated with policy design, administration, monitoring, permitting, enforcement, or other activities.

- Industry may incur costs to modify production plants and equipment, alter operating practices, institute new waste disposal practices, or change their labor mix.

- Consumers may incur costs in making their homes more energy efficient, or by paying higher prices for goods and services or spending more time and effort recycling waste products.

- Product quality, innovation, or general productivity may be adversely affected; if the same resource investments yield less benefits in any of these ways, society has realized some new cost.

- Policies may displace resources such as labor or capital equipment; if resources do not find equivalent employment elsewhere in society, then their displacement also imposes a long-term cost on society. Cost also results from unemployment, because local industries that service the industry where jobs are lost may also suffer. Even if resources do become employed elsewhere, the transition between jobs, or movement of financial capital, can be unpleasant, and, at the least, imposes the transitional costs, or "transactions costs", on society.

Costs that fit these categories can be analyzed at a variety of levels or from a variety of perspectives. Exhibit 8-4 discusses some of the levels of information states may want to include in their cost analyses.

In the policy analytic framework, aggregated social costs may be a key policy evaluation criteria. A common approach for estimating social costs related to each policy option from all the sources listed above involves six basic steps:

Exhibit 8-4: Dimensions of Costs

Depending on the level of analytic complexity a state needs or wants to adopt, social costs can be assessed with regard to various dimensions or perspectives. These include:

- *breadth* - the number of affected activities;
- *depth* - the level of quantitative and detailed cost estimates for these activities; and
- *scope* - the range of the effort to locate secondary effects (and costs) of these activities (e.g., does the effort to analyze costs and economic impacts extend beyond the primary market affected).

Expanding an analysis along any of these dimensions can provide additional valuable information, but also requires more resources. In its simplest form, cost information can be presented as an inventory of activities that are sources of costs. For example, sources of costs to industry might include retooling equipment or increasing quality control, filling out reporting forms, interacting with technology transfer committees, and hiring more educated labor to use more complicated equipment. An intermediate form of analysis involves seeking to quantify, using engineering cost studies and other information, each activity and source of cost. Where significant price and output effects are expected, the analysis can be expanded to include a representation of demand and supply conditions in the relevant market(s). This is frequently called partial equilibrium analysis. The most complex form of cost analysis uses general equilibrium models that capture multi-sector interactions and subsume a variety of markets (see Section 8.7).

1. *Determine who in society will be affected by the policy.* This means identifying and listing each type of public and private sector actor that will incur new costs. This may include government agencies, small and large firms, individual consumers, and others.

2. *Separate the affected community into homogenous groups.* This means creating groupings or categories of actors that are similar to each other in terms of how they conduct their business, both before and after the policy is enacted. The point is to group together actors who are likely to react in a similar manner to the new policy. Some groupings, such as one type of small industry, will be heavily affected and will need to change their operations significantly, while a different type of small industry will only need to make small changes. These should be classified as separate groups even though each is part of the broader small-industry category.

3. *Determine the base-line costs for each group.* This means identifying the procedures or operations that will change for each group under the new policy and calculating the current pre-policy costs of those procedures. For example, if production processes, waste disposal, or record keeping will change, costs associated with these activities should be calculated before the changes take place. These calculations should be sure to incorporate both operating and capital costs.

4. *Determine new cost levels for each group.* Given the new policy, calculate the expected operating and capital costs associated with the modified procedures. This means figuring out the costs associated with conducting business if the new policy is in place.

5. *Calculate the incremental cost of the policy for each group*. For each group, subtract the pre-policy costs (the base-line from step 3) from the post-policy costs (step 4) to determine the incremental costs to the group of the new policy. In some cases, incremental costs can be

calculated directly, without first specifying the baseline in Step 4 (*i.e.*, the baseline is implicitly zero). For example, the cost of planting shade trees in residential neighborhoods can be calculated directly as the cost of labor, seedlings, etc.

6. *Calculate total cost.* Sum the incremental costs from all the affected groups into an aggregate annual cost figure for the policy in all years that the policy has costs. As Exhibit 8-5 discusses, economists and policy-makers usually include the present value of costs that will be incurred

Exhibit 8-5: Time Frames and Cost Analysis

Social costs generally fall into one of two classes: one-time, up-front costs (such as equipment purchases), and recurring annual costs (such as compliance reporting or increased equipment maintenance costs). Because costs may vary over the time-period of the analysis, cost information can be presented for decision-makers in a variety of ways. Actual annual costs are useful, for example, because the bulk of adjustments to new government policies often occur in the first few years the policy is in effect.

For comparing diverse policies, however, an aggregate measure of costs on a common scale is needed. *Present value* is one measure that transforms streams of future costs -- using a discount rate -- into a measure of comparable worth today. Section 8.5 describes alternative approaches to selecting the social discount rate to apply to projected future costs in order to calculate their current value. Comparisons of present value, however, can be complicated by questions of how to truncate the streams of costs that are compared.

A complement to calculating present values is *annualized costs*. Annualizing costs converts the stream of actual costs into a constant cost stream. Annualized costs provide a metric for comparing policies that have different lifetimes over which they would naturally be analyzed. For example, policies involving process changes at an electric utility would generally include cost analysis over 30 years, the expected lifetime of the plant. In contrast, forestry projects would naturally be analyzed for one or more tree rotation lengths, which vary widely by tree species. Annualizing costs provides one method for comparing these two options.

Annualized costs are also useful when comparing programs that involve non-monetized benefits, such as emissions reductions. In this case, annualized costs can be compared to average annual emissions reductions to calculate the cost-effectiveness of alternative policies. Present value costs can be similarly compared to cumulative annual emissions reductions, providing similar, but not identical, results.

throughout future years because of the new policy.

8.3.2 Complications Associated with Social Cost Calculation

Estimates of the total costs associated with each policy option can be used for describing policies and illustrating tradeoffs within the analytical framework. States should be aware of several areas for caution, however, when conducting these calculations.

First, costs should not be double-counted. In some situations the same cost may filter its way through different groups of actors but should not be included in the aggregate cost calculations more than once. Higher costs to firms, for example, may be passed on to, and result directly in higher prices for, consumers. This cost should *not* be calculated and incorporated for both these actors, since it really represents only one net increase in total costs to society.

The second area for caution involves explicitly distinguishing wealth transfers from real resource allocation costs. As noted above, transfers of money or resources between groups of actors do not represent real costs to society. A large part of the impact of tax revenues, for example, is a transfer of wealth from citizens or private organizations to the government. While non-cost elements of these types of wealth transfers are certainly relevant in program evaluation, they should not be directly incorporated into social cost calculations. Other aspects of taxes may in fact represent true social costs, such as market distortions or potential long-run losses in productivity or competitiveness. Section 8.4 discusses this issue in more detail.

The final caution regarding social cost calculations is that apparent price impacts may actually be rooted in factors external to the new policy. While such changes may affect costs between the pre- and post-policy scenarios, they are not part of the incremental cost of the policy. For example, an external influence may cause refrigeration or air conditioning prices to rise regardless of new emission reduction policies. While these price changes may induce (or reflect) real costs to society, they are completely unrelated to climate change mitigation policies and their effects should be included in the baseline and not in the social cost calculations.

8.4 ESTIMATING OTHER IMPACTS

Greenhouse gas emission reduction policies may have a number of important impacts in addition to those quantified in standard social benefit and cost calculations. General effects on the economy, on specific sectors of the economy, and on different income classes within urban or rural populations are all similar concerns in the state policy making environment. These impacts influence the desirability of alternative policy strategies, and also affect public attitudes, the political feasibility of climate change programs, and the financial or other resources allocated to climate change mitigation efforts. While these political and administrative factors are difficult to separate or measure during policy analysis, they are critically important to long-term success in combating global climate change.

Political and organizational implications can result from financial factors, such as the wealth transfers discussed in Section 8.3, induced by policy change. These impacts may cause serious economic disruption within a region or may undermine other public policy objectives but will not appear in social cost calculations because they only represent shifts of resources among segments of society. Plant or mine closures in one region of the country, for example, may yield net benefits to society in terms of combatting damage to the environment and human health, but may undermine the region's economy. This same policy action may result in high rates of temporary unemployment and migration of people to other states. Obviously, state policy-makers must consider these factors.

Within the policy analytic framework explicit evaluative criteria can be created for each area of social concern. Including political feasibility or social equity criteria in the policy matrix, for example, ensures that these issues will be considered in evaluating every policy option. Chapter 4 presents a number of potential criteria that states might employ; the exact criteria a state defines will reflect local priorities and circumstances. The potentially important policy impacts sometime ignored by social benefit and cost calculations include:

- *Impacts on Specific Sectors of the Economy.* For example, transportation and agriculture may be most affected by some measures, while the residential sector and industry may be hit harder by others. The division of impacts between sectors may be considered favorable or unfavorable by state policy-makers depending on their priorities. If the state is trying to reduce emissions largely within one sector, for example, then a criterion that highlights how each policy affects that sector may be worth developing. On the other hand, states may wish to protect rather than target certain sectors; well-developed criteria can help account for this concern as well.

- *Impacts on Employment.* When jobs are permanently lost so that individuals remain unemployed, or if new jobs are less productive or lower paying than lost jobs, there is an economic cost since the output is lower. Labor shifting between jobs, however, is not necessarily an economic cost. Nonetheless, job loss is obviously an important social issue, as well as being politically significant. The degree to which policies induce labor shifts is, thus, usually a critical consideration in policy analysis.

- *Regressivity or Progressivity of the Policy.* Policies may extract greater payments from some income classes than from others. Taxes on household products, for example, are generally considered to impose a greater burden on low income households because these households spend a higher proportion of their annual income on such products than do households with higher incomes.

- *Impacts on Government Finances and Revenues.* Most policies will affect government finances in some way. Measures that require high levels of administration and enforcement by government agencies, for example, may demand significant dedicated budget allocations. Taxes to reduce consumption of greenhouse gas producing products and activities, on the other hand, will raise government revenues. Whether or not these issues are legitimately factored into social cost calculations, they will have certain political and administrative implications that may be important to consider during policy planning.

- *Impacts on Other Government Work.* Depending on how new programs or policies are administered, they may disrupt current government operations. If a new program in a state energy office, for example, requires staff time for administrative and other functions, current activities may be displaced or disrupted. While such impacts do represent a social cost, they are often ignored, especially if no new resources, such as budgets or employees, are allocated to help cover the new activities.

8.5 GENERAL COMPLEXITIES IN ESTIMATING POLICY IMPACTS

The above sections on benefits, costs, and other impacts highlight potentially important evaluative criteria. Impacts of climate change and of climate change policies, however, may both extend many years into the future and be highly uncertain. The policy-maker, therefore, is charged with selecting an analytical framework that adequately addresses the decision-making problem. In this context, complexities surrounding policy evaluation fall into one of two categories: 1) assumptions that underlie how states will treat social risk and social value over time; or 2) limitations on applicable policy evaluation procedures that are rooted in the uncertainty surrounding climate change.

Specific issues relating to each of these types of complexities are introduced below. These include determining social discount rates to use in policy analysis, dealing with uncertainty regarding policy impacts, and dealing with uncertainty about the impacts of climate change itself. States may wish to consider these issues and establish standards for dealing with them before conducting full-scale policy analysis.

Determining Social Discount Rates

Policy-makers must consider the future ramifications of greenhouse gas emission reduction policies. Because discount rates are generally used to calculate the present value of benefits and costs that accrue in the future, alternative discount rates and alternative methods of applying them carry significantly different implications for policy development. The information presented in this section introduces some of the foremost considerations surrounding selection and application of specific discount rates. Policy-makers interested in this issue may wish to review the extensive economic literature on discounting and environmental policy.[3]

The fundamental issue underlying the choice of a specific discount rate is that higher rates will result in lower valuation of future costs and benefits. As a result, a higher discount rate will weight future policy impacts less in current decision making. At a discount rate of 0%, for example, future costs and benefits are treated exactly the same as current costs and benefits; a $100 impact observed fifty years from now would be considered equivalent to a $100 impact felt today. At a 5% discount rate the same $100 future impact would be valued as $8.72. Similarly, at a 10% rate it would be valued at $0.85. Discounting is especially relevant to greenhouse gas emission reduction policy development and selection since climate change is such a long-term issue.

There is a considerable body of literature discussing what the appropriate discount rate is for public policy decision-making. Most economists would argue that the rate should not be zero. Rather, costs and benefits incurred in the future should be weighed less heavily than current costs and benefits; because resources today can be invested in the future, using a positive discount rate is analogous to financial decisions that firms make when comparing streams of costs and revenues. Moreover, individuals tend to weigh current costs and benefits more than future costs and benefits in their own decision-making. For example, individuals often prefer a less expensive product to a more expensive product that is more reliable and will be less costly to own and operate in the long run.

Because of ethical issues surrounding discounting, many analysts argue for the use of low discount rates. The inter-generational nature of long-range planning, for example, necessitates that some of the parties who will experience the costs and benefits of policies do not yet exist. Many individuals will not be born and organizations not formed until some time in the future. Given this situation, the irreversible nature of potential threat from climate change may require greater caution (i.e., a lower discount rate). Conversely, it has been argued that the current generation should treat future generations exactly as we would treat ourselves, potentially resulting in higher discount rates. These are issues that states should consider and evaluate in more detail.

Assuming these ethical questions are resolved, numerous practical questions remain as to the choice of an appropriate discount rate. The economic debate about what the discount rate should be examines a variety of issues, including the real resources that are displaced by the investment, riskiness, and other factors. In general, decisions by businesses and private individuals are made using private discount rates that are usually higher than social discount rates used by governments to set policy. Thus, measures that may not be implemented by individuals or industries on their own, may, nevertheless, be cost-beneficial from a social perspective.

Inherent Uncertainty in Valuing Impacts of Climate Change Policies

Social benefits are typically measured by economists as the damages avoided by taking some policy action. For example, the benefits of climate change mitigation are equal to the value to society of

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[3] For more information, see Lind, 1982. States may also want to review the U.S. Office and Management and Budget's (OMB) analyses of social discount rates as they apply to federal programs (OMB Circular A-94, Revised October 29, 1992).

avoiding any negative impacts of climate change in the future. Although available estimates suggest that the climate changes associated with a warmer planet may have significant implications for the environment, the economy, and human health, estimates of the value of avoiding these changes are incomplete and uncertain. Estimating the impacts and associated future costs of climate change is, thus, a primary focal point of current national and international research.

Because of these complications, as Section 8.2 explains, the amount of emission reductions policies achieve is most often used to measure the benefits of different policies to mitigate climate change. Since this assumes that greater benefits result from emission reductions, there are direct implications for the analytic methodologies states use to evaluate policies. As suggested later in this chapter, for example, analyzing policies based on emission reductions encourages cost-effectiveness rather than benefit-cost analyses (see Section 8.6).

States deal with the issue of uncertainty surrounding climate change impacts through the level of effort that they devote to climate change mitigation programs. States that want to wait until the uncertainties are reduced, or that do not recognize their significant potential for helping mitigate this problem, either take no action or pursue a conservative approach. Alternatively, states that believe it is worth acting amidst these uncertainties, on the other hand, often tend to be more aggressive in developing mitigation policies. In either case, however, the amount of greenhouse gas emission reductions attained through various policy options still usually serves as the proxy for the benefits of mitigating climate change since the actual "avoided damages" of not addressing climate change are impossible to quantify, though they may be significant.

Uncertainty Regarding Policy Impact

The actual impact of some policy options on greenhouse gases can also be difficult to measure and forecast. The uncertainty is especially relevant for policies that provide indirect emissions control, such as financial incentives or educational programs, for policies that span long time frames, and for policies that may interact with other emission reduction policies or with other state initiatives. Actually calculating emissions reductions may require a sophisticated understanding of the policy and the sector affected. If policy analysts do not know exactly how price changes affect fertilizer demand, for example, then the effect of a nitrogen-based fertilizer tax will be uncertain and emission reductions will be difficult to quantify. Some policies to decrease fossil fuel consumption in the residential or transportation sectors may escalate the demand for electricity, which may offset reductions in greenhouse gas emissions, depending on what type of power plants supply the additional electricity. These positive and negative interactions are most difficult to predict in the long term when other economic or social fluctuations will affect greenhouse gases and policy success as well.

Similarly, education policies are critically important but are difficult to link explicitly to components of the equations for computing emissions. Acknowledging these issues is especially important for ensuring that some critical programs, such as public education and long-term urban planning, are not dismissed or ignored because they cannot be linked to direct emission reductions.

8.6 BASIC METHODOLOGIES FOR EVALUATING CLIMATE CHANGE ISSUES

Depending on state goals, resources, and institutional capacity, policy analysis to evaluate greenhouse gas reduction options and to account for the complexities listed above can be conducted with a range of methodologies or analytic tools. The policy analytic framework highlighted in this chapter represents one way to frame the climate change issue as a whole and illustrate the tradeoffs between different options. A variety of alternative or supplemental approaches may enhance climate change policy analysis. These can range from simple computer spreadsheet approaches to complex and comprehensive modeling efforts, either of which can be supplemented by economic or engineering research. While the full range of these approaches cannot be discussed here in detail, some of the general issues and the basic structures that states might consider are worth reviewing.

The analytic approach for examining particular policy options can become increasingly complex depending on the factors and levels of information a state wishes to incorporate. A simple approach for states to follow is to rank different options based on how well they meet each criterion. More substantial information may be desirable, however, such as an understanding of the precise magnitudes of various policy impacts. In cases where benefit or cost estimation is not straightforward, states may want to use methodologies such as risk analysis, econometric evaluation, linear programming, and other analytic tools. The remainder of this section reviews decision making constructs that include benefit-cost analysis, cost-effectiveness analysis and multi-criteria decision making.

In the end, the particular methodologies and tools a state uses to conduct climate change policy analyses will depend on local circumstances, including resource and institutional constraints. It is perhaps obvious, but important, that there is a trade-off between obtaining solid and reliable information and the cost and time expended in accumulating that information. For many states, this may suggest using simpler decision guidelines unless they can work with other governments or regional coalitions on more comprehensive projects.

The types of policy analysis and decision making methodologies summarized below, as well as others not listed here, are not necessarily exclusive, but may overlap and complement each other in various ways. In addition, the risk, time frame, and discounting issues discussed above are common and fundamental to all these approaches. Extensive and more complete literature is available on all these topics; the information presented here is intended only to provide examples to state policymakers for ways to analyze policy options.

Benefit-Cost Analysis

Benefit-cost analysis offers a framework for choosing among alternative policy options that involves monetarily valuing the impacts of the policies under consideration and selecting the policies with the highest net benefits. This approach attempts to account for *all* benefits and costs, including difficult-to-monetize effects such as ecosystem damage or effects on human health.[4] This process may have limited usefulness in the current context, because of the cost and problems involved in comprehensively quantifying the value of climate change impacts at the state level. Further, many state and federal agencies, including EPA and OTA, as well as private researchers, have investigated and quantified at least a portion of these impacts, for some regions or nationally (Cline, 1992; Fankhauser, 1994; IPCC, 1992a; Nordhaus, 1994; OTA, 1993; and U.S.EPA, 1989). Extensive economic literature is available on benefit-cost procedures and different means of valuing non-quantitative factors.

Cost-Effectiveness Analysis

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[4] Typically, benefit-cost analysis involves the following steps: (1) measuring, in monetary terms, all of the costs and benefits of each policy over time; (2) for costs and benefits that occur in the future, calculating their present value by application of an appropriate discount rate; (3) calculating the net benefit of each policy by subtracting the present value of the costs from the present value of the benefits; and (4) choosing the policy option that offer the highest net benefits.

Cost-effectiveness analysis simplifies policy analysis by allowing one policy impact, such as the benefits of climate change mitigation, to be measured in non-monetary terms. If emissions of different greenhouse gases are represented on a common scale, such as 100-year estimated global warming potential (GWP), cost-effectiveness promotes calculation of a dollar-per-unit-GWP-reduced figure. This same analysis can be conducted with any other common scale, such as tons-of-carbon-equivalent emissions reduced. While cost effectiveness analysis lets policy-makers rank options on a common cost-per-unit scale, policy-makers must still determine which or how many of those policies to enact. Exhibit 8-6 illustrates these points.

Exhibit 8-6: Sample Results of Cost-Effectiveness Analysis

This table illustrates the results of cost-effectiveness analyses. While in an ideal situation data are available to generate these types of numbers with precision, in reality the cost and emissions-reduction figures are often subject to high levels of uncertainty. The data below do not represent the results of actual analyses:

Sample Policy Option	Hypothetical Associated *Cost-per-ton* of Carbon Equivalent Emissions Reduced	Total Potential Emission Reductions (tons)
1) Methane Recovery Technology Demonstration and Support	$54.00	58.4
2) Methane Emissions Tax	$31.00	123.0
3) Alternative Fuels Subsidy	$45.00	456.9
4) . . .	. . .	. . .

Given these constraints, cost-effectiveness analysis often serves as a basis for selecting a least-cost combination of policies to achieve some preset goal, such as a 20% overall emission reduction by some target year, or as a basis for selecting the combination of policies that will bring the highest level of emission reduction benefits given a certain financial or other resource constraint. For example, states can use this type of analysis to calculate the highest level of emission reductions possible given a preset budget.

Multiple Attribute Decision Analysis

A variety of analytic methodologies facilitate the structured consideration of multiple and diverse social objectives during policy evaluation, such as considering emission reductions costs, political feasibility, and social equity at the same time. By weighing evaluative criteria, assigning probabilities to certain policy outcomes, and developing utility functions to represent the value of these outcomes, these methodologies allow decision makers to consider policy impacts on diverse criteria that cannot be expressed in common units. The end product of this type of decision analysis is usually a probability-based prescription for what policy or combination of policies offers greatest expected social benefit. This analysis hinges on a well-defined set of data inputs and constraints.

Extensive literature is available on the types and different policy applications of decision analysis methodologies. The most straightforward of these methodologies allocates probabilities and payoffs to all the potential benefits and costs associated with alternative policy choices. This process, best serving decision makers and analysts who face uncertain outcomes from a set of given actions, is often incorporated into various stages of cost-effectiveness and benefit-cost analysis. It is generally used to determine the expected value of options or policy impacts by combining the probabilities of different potential outcomes with weights assigned to the social value or utility of those outcomes. Exhibit 8-7 illustrates some of the components of multi-attribute decision analysis.

A more complex but similar technique is called the Analytic Hierarchy Process (AHP).[5] This is a procedure that specifically attempts to provide structure to multi-criteria decisions involving problems of

Exhibit 8-7: Sample Multi-Attribute Decision Analysis

Due to its complexity, multi-attribute decision analysis can not be thoroughly illustrated here. This box shows the types of information that might factor into two stages of this kind of analysis. The information here is only a simplistic representation of this type of analysis and does not reflect many of the details and complexities involved.

Stage 1: Assign Probabilities and Values to Possible Policy Outcomes

Regarding a specific policy option, such as an alternative fuels subsidy, policy makers might decide that there are three possible outcomes within a five-year time frame, each carrying a certain value. The "value", developed as an earlier part of the analysis, may be derived from emissions reduction projections, costs, and other factors; extensive analytic processes exist for defining and developing both "value" and "probability" estimates. The sample below is only illustrative and does not represent an actual analyses.

Sample Possible Outcomes	Value of outcomes ($ or some other measure)		Probability		Value * Probability
1) Successful conversion to alternative fuels	$11,380	*	.25	=	$2,845
2) Partial conversion to alternative fuels	$2,385	*	.60	=	$1,431
3) Citizens reject or legislature repeals the policy	$0	*	.15	=	$0
	Sum Expected Value of this Policy Option				$4,276

Stage 2: Analyze Alternative Policies Based on Expected Values

Depending on the analytic structure chosen, policy makers may be able to compare the sum expected values of different policy options, or combinations of options, and select those with the highest expected values, given the predetermined probabilities and outcomes. Results of this analysis could look like the following:

Policy Option	Expected Value
1) Methane Recovery Technology Demonstration and Support	19,784
2) Methane Emissions Tax	7,900
3) Alternative Fuels Subsidy	4,276
4) . . .	. . .

[5] For more information on the Analytic Hierarchy Process, see Dyer, 1992.

choice and prioritization between criteria, as climate change policy formulation does. Using AHP, policy-makers develop a decision hierarchy that identifies and compares alternatives. The broad approach is to structure the complex decision first and then to focus attention on individual components of that decision, using subjective judgements (as supported by the process itself) on aspects of the problem for which no quantitative scale exists. Certain computer software tools are designed specifically to support this type of analysis. The fundamental benefits of this approach is that it structures complex decisions, provides a reliable mechanism for ranking non-quantitative issues, and focuses on objectives that policy-makers are trying to achieve rather than on the explicit alternatives. While there do not appear to be applications of AHP in the climate change field, it has been used for some renewable energy and sustainable resource analysis.[6] States may want to investigate these techniques further.

8.7 MORE COMPLEX TECHNICAL TOOLS FOR ASSESSING GREENHOUSE GAS POLICIES

Some regional, national, and international analysts are using technical tools beyond the methods described in this chapter to deal with the complexities surrounding climate change. This section illustrates a limited set of the tools that have been applied to address the following tasks:

- Demonstration of technical issues in global change;
- Policy exercises involving stabilizing of emissions, atmospheric composition, or climate;
- Risk assessment pertaining to climate change; and
- Risk management pertaining to climate change.

The information in this section is derived largely from national and international sources, and may not apply at regional and state levels, especially given local goals and agendas. If states choose to investigate complex modeling, cooperative arrangements with relevant research and federal institutions and with other states may facilitate the application of more complex methodologies to the development or implementation of state policies on greenhouse gas emissions. The tools listed here require significant investment of financial and other resources to develop.

There is currently no single tool that simultaneously addresses all of the above tasks. Some of the methodologies that are applicable to greenhouse gas policy analysis are summarized in Exhibit 8-8. An example of one of the more comprehensive methodologies is the Integrated Model to Assess the Greenhouse Effect (IMAGE), developed by the National Institute of Public Health and Environmental Protection (RIVM) of the Netherlands. Exhibit 8-9 provides a diagram of IMAGE's modular structure. Note in particular the following assessment tiers in the overall methodology, illustrated in that diagram:

- Energy/economics and land use models;
- Atmospheric composition models;
- Global and regional climate impact models; and
- Socio-economic impact models.

[6] For example, the Analytic Hierarchy Process contributed to biomass energy assessments by the Southeastern Regional Biomass Energy Program.

Exhibit 8-8: Sample Methodologies for Analyzing Greenhouse Gas Policies

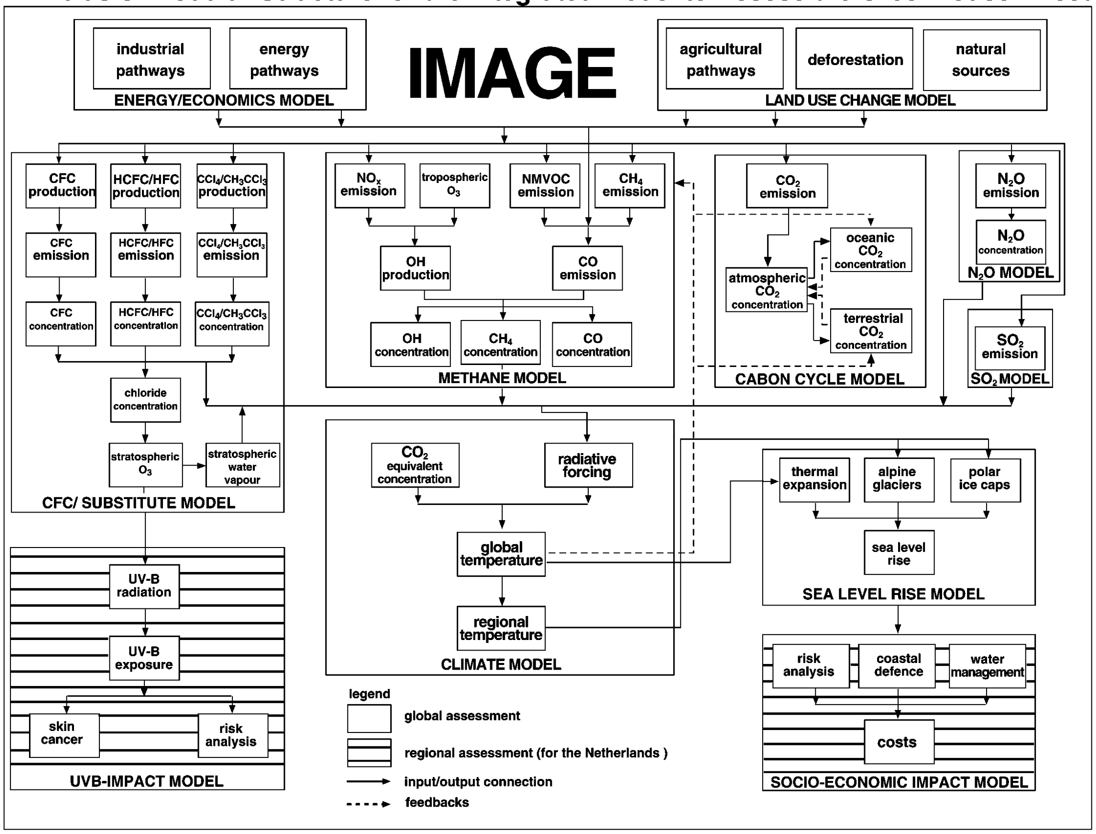
Acronym Model	Energy Use Model	Emissions	Atmospheric Composition Model	Climate Impacts Model	Socio-Economic Impacts	Scale
PC-AEO	Yes	No	No	No	No	Regional
TEMIS	Yes	Yes	No	No	No	Urban
ISAAC	Yes	Yes	No	No	No	Regional
MARKAL	Yes	Yes	No	No	No	Regional
IEA/ORAU	Yes	Yes	No	No	No	Global
DICE	Yes	Yes	Yes	Yes	Yes	Global
ASF	Yes	Yes	Yes	Yes	Yes	Global
MAGIC/	Yes	Yes	Yes	Yes	No	Global
ESCAPE	No	No	No	Yes	Yes	Regional
IMAGE	Yes	Yes	Yes	Yes	Yes	Regional
DRI/ McGraw-Hill	Yes	Yes	No	No	Yes	National/ Regional
REMI*	Yes	Yes	No	No	Yes	Regional
IDEAS (DOE)	Yes	Yes	No	No	Yes	National

* Regional Economics Models, Inc.

The regional assessment capability of IMAGE is limited to impacts specific to the Netherlands. A similar comprehensive methodology, the MAGIC and ESCAPE models of the Climate Research Unit (CRU) of the University of East Anglia, can be used to examine regional impacts in Europe. Ongoing development efforts by the U.S. Environmental Protection Agency's Office of Policy, Planning and Evaluation and at Batelle Pacific Northwest Laboratory are expected to yield comprehensive policy models that are applicable to the United States at the national and regional levels.

Policy-makers interested solely in stabilizing emissions or atmospheric concentrations of greenhouse gases, rather than in policies that address climate stabilization or the full range of socio-economic impacts, may not necessarily need to resort to a comprehensive assessment model. The Dynamic Integrated Climate-Economy (DICE) model of Nordhaus (1992), which utilizes a global, inter-temporal general-equilibrium model of economic growth and climate change, provides simpler estimates of global impacts. A more complex model used within the United States is the EPA's Atmospheric Stabilization Framework (ASF), which combines energy/economics and land use models and atmospheric composition models with a highly simplified global impacts models.

Exhibit 8-9: Modular Structure for the Integrated Model to Assess the Greenhouse Effect



The IMAGE model was developed by the National Institute of Public Health and Environmental Protection (RIVM) of the Netherlands. Details regarding its structure and application are available in the RIVM brochure, Global Change Research Programme: An Overview.

Several methodologies are solely applicable to estimating energy use and/or accompanying emissions of greenhouse gases amd have extensive economic modeling components. At the global level, there is the ORAU energy/economics model of carbon dioxide emissions developed by the International Energy Agency. A spreadsheet model that can be employed to forecast regional industrial energy use, but does not estimate greenhouse gas emissions, is the U.S. Department of Energy's PC-AEO model, which is coded in Lotus 1-2-3. An especially useful regional emissions model is MARKAL, which has been adapted to evaluate carbon dioxide emission control strategies by the New York State Energy Office. Other methodologies for forecasting CO_2 emissions are the Joint Decision Analysis Model (ISAAC), which was developed by the Bonneville Power Administration and used to examine future emissions in the Pacific Northwest by the Oregon Department of Energy, and the Total Emissions Model for Integrated Systems (TEMIS), which is a fuel cycle model developed by the OKO Institute in Germany and is best used to simulate urban emissions, when specific local data are available.

CHAPTER 9
PREPARING THE STATE ACTION PLAN

The previous chapters provided some detail on the issues with which states should deal and the processes they should go through when developing their Climate Change Action Plans. This chapter is intended to assist states in developing an organizational framework for presenting the information in their plans.

While each state bears chief responsibility for drafting its own plan, it is important to bear in mind that climate change is a global issue and that the nation has made an international commitment to reducing greenhouse gas emissions. Each state's action is part of a concerted, national effort. It is therefore possible and desirable to identify components of a State Climate Change Action Plan that should be common to all states. An action plan should contain at least the following elements:

- Executive Summary
- Background on the Science of Climate Change
- Regional and Local Risks and Vulnerabilities
- 1990 and Forecast Baseline Emissions
- Goals and Targets
- Alternative Policy Options
- Identification and Screening of Mitigation Actions
- Forecast Impacts of Mitigation Actions
- Recommendations and Strategy for Implementation

Each of these elements of the action plan will be discussed in turn, with references to the appropriate sections of this guidance document.

9.1 EXECUTIVE SUMMARY

This section summarizes the Plan's conclusions and recommendations.

9.2 BACKGROUND ON THE SCIENCE OF CLIMATE CHANGE

For some readers, the Plan will serve as their first introduction to the issues surrounding climate change, while others may already be well educated about the subject. A concise presentation on the science of climate change and the history of national and international climate change policy, as discussed in Chapter 2, will help to educate readers about the problems confronted in the Plan.

9.3 REGIONAL AND LOCAL RISKS AND VULNERABILITIES

The global phenomenon of climate change will manifest itself at the regional and local levels. To the extent possible, states should anticipate the local and regional manifestations of climate change, such as shifting patterns of agriculture, increased incidence of temperature-related diseases, and risks to water resources.

9.4 1990 AND FORECAST BASELINE EMISSIONS

As discussed in Chapter 3, identifying major sources of anthropogenic greenhouse gases will enable states to prioritize various policy initiatives. This inventory of greenhouse gas emissions will also establish a baseline against which the effectiveness of mitigation activities may be measured. For inventories developed in partnership with EPA, states are requested to use the year 1990 as their baseline year. The choice of 1990 as a baseline is consistent with the nation's international commitment under the *Framework Convention for Climate Change* to return the nation's greenhouse gas emissions to 1990 levels by the year 2000.

To evaluate the set of mitigation actions contained in the Plan, each state should also forecast a baseline set of emissions. The forecast (see sec. 3.2) baseline scenario describes a future in which a state conducts "business as usual," pursuing no initiatives specifically targeted to reduce or sequester greenhouse gases. At the same time, the baseline scenario must portray the expected economic, social, demographic, and technological developments over some future time horizon. The maximum time frame for projecting emissions is generally 15 to 20 years.

9.5 GOALS AND TARGETS

Once baseline emissions have been forecast, each state should commit to attaining realistic, measurable goals of greenhouse gas reduction or sequestration, as discussed in Chapter 4. Using the baseline forecast, states may establish reduction or sequestration goals over a given period of time (see sec. 7.1).

9.6 ALTERNATIVE POLICY OPTIONS

Although this guidance document is intended to assist states in formulating mitigation strategies, *i.e.* strategies to reduce greenhouse gas emissions, states may also choose to develop strategies that will allow them to adapt to the potential changes that climate change may generate. States should discuss these adaptation strategies in a separate section, distinct from mitigation strategies.

9.7 IDENTIFICATION AND SCREENING OF MITIGATION ACTIONS

Based on the guidance provided by Chapters 5 and 6, states can begin to identify policy options to reduce greenhouse gas emissions. These options can then be analyzed, as discussed in Chapter 8, to select mitigation actions that are economically viable, politically feasible, and technologically plausible.

When identifying and screening mitigation actions, states should also describe the process through which they arrived at their conclusions. They should discuss:

- the political infrastructure that ensured the Plan's formulation (see secs. 7.2, 7.3, and 7.4);
- the development and application of selection criteria used to screen mitigation actions (see sec. 4.3); and
- the analytical tools used to compare mitigation options (see Chapter 8).

9.8 FORECAST IMPACTS OF MITIGATION

Once a state has identified those mitigation actions that are economically viable, politically feasible, and technologically plausible, it should analyze and communicate the benefits of these actions through the use of mitigation scenarios. Mitigation scenarios are not predictions of the future. Rather, they allow policymakers and the public to imagine the future by modeling the effects of a wide range of policy initiatives.

The mitigation scenario describes a future similar to the baseline scenario with respect to underlying economic and demographic trends; however, it assumes initiatives are taken to address the issue of climate change. The mitigation scenario should take into account both the technical potential for reducing or sequestering greenhouse gases and the institutional, cultural, and political constraints that may prevent a state from exploiting all technical possibilities. States may develop several mitigation scenarios based on different assumptions that vary according to the degree to which they yield greenhouse gas reductions.

It is beyond the scope of this guidance document to go into the specifics of the various models that have been developed to generate long-term forecasts of climate-related phenomenon. Forecasting emissions relies on such uncertain variables as population growth, energy consumption and changing sources of power, number of automobiles, and changes in the agriculture and forestry sector. Section 3.2 of this guidance document provides a broad overview of forecasting methods. Whichever forecasting method a state uses, it will probably involve three essential broad types of activities: data collection and analysis; quantification of emissions/reductions/sequestration; and extrapolation.

- *Data Collection and Analysis.* Currently, greenhouse gas emissions are estimated by multiplying data that measure the level of activity that generates greenhouse gases (hereinafter referred to as *"GHG activities"*) with the appropriate greenhouse gas coefficient. It is therefore necessary to collect these data, which can be accomplished when states complete their greenhouse gas inventories (see sec. 3.1).

  Some effort must also go into collecting data on the parametric assumptions that underlie the scenarios. States should determine and define which societal indicators—such as population growth, GDP, market penetration rate for certain technologies—significantly affect GHG activities. These key parameters will be used to make extrapolations of greenhouse gas emissions in the future.

- *Quantification of Emissions/Reductions/Sequestration.* Methods currently exist to estimate greenhouse gas emissions based on data on GHG activities (*see* EPA's *State Workbook: Methodologies for Estimating Greenhouse Gas Emissions*). States should develop methodologies to quantify the greenhouse gas reduction or sequestration associated with their set of mitigation actions.

- *Extrapolation.* States should develop a model—a quantitative means to express the relationship between the key parameters and GHG activities—that permit estimates of the level of GHG activity from a given parametric value. To forecast future levels of GHG activity, projected values of the key parameters can be input into the model. These projected parametric values may be exogenous (*i.e.* external to the model) or may be based on assumptions and algorithms incorporated within the model.

9.9 RECOMMENDATIONS AND STRATEGY FOR IMPLEMENTATION

The ultimate product of a state's analytical efforts in developing a Climate Change Action Plan is a set of policy recommendations and a strategy to implement those recommendations. The implementation strategy should clearly lay out the tasks that must be accomplished, the agencies or parties responsible for accomplishing those tasks, and a timeline for implementation.

Depending on their implementation strategy, states may organize their policy recommendations in a variety of ways. States may organize recommendations by:

- targeted sector (*e.g.* utilities, transportation, agriculture);
- fuel source (*e.g.* coal, gasoline, natural gas);
- amount of greenhouse gas reductions anticipated;
- cost of implementation; or
- governmental role (*e.g.* legislative actions, regulatory actions, voluntary actions).

States who respond to the challenge of climate change face a daunting mission, but one that is critical to the world's well-being. The scientific evidence strongly suggests that increasing the concentration of greenhouse gases will alter global climate. While the effects of global climate change are uncertain, they could be substantial. Sea-level rise could inundate many coastal areas, entire species could be threatened with extinction and ecosystems lost.

This guidance document outlines procedures and strategies that states may use to implement initiatives that not only reduce greenhouse gas emissions, but that conserve energy and enhance economic efficiency as well. Hopefully, it will help to facilitate continued collaborations among the state, local, and the federal governments and to encourage states to forge innovative, creative, locally-based approaches to risks that threaten the global commons.